

August 2017

Quack and wheat grasses.

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Recommended Citation

Pammel, L. H. (2017) "Quack and wheat grasses.," *Bulletin*: Vol. 7 : No. 83 , Article 1.
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Bulletin 83

July, 1905

EXPERIMENT STATION

IOWA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS
AMES, IOWA

BOTANICAL SECTION

1. QUACK AND WHEAT GRASSES
2. SOME SOIL BINDING GRASSES OF IOWA

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QUACK AND WHEAT GRASSES.

BY L. H. PAMMEL.

The quack and wheat grasses of Iowa, eastern North America, and the Rocky Mountains are important, not only as weeds, but as forage plants. One of the most valuable of these is the western wheat grass, ranging from the eastern slopes of the Rockies into western Iowa. Besides this species there are several others more or less common in the western and northwestern portion in the state. Some of these are considered valuable as forage plants, yet during the past season many complaints have been made of the abundance and weedy nature of the quack grasses in North America. It seems wise, therefore, to consider the quack and wheat grasses not only as weeds, but also from the standpoint of their value as forage plants.

QUACK GRASS, AGROPYRON REPENS BEAUV.

DESCRIPTION.

Quack grass is a perennial, with a many-jointed, creeping rhizome (rootstock). Culm from eighteen inches to four feet high, bearing numerous leaves from five to twelve inches long, and from one-third to one-half inches wide, margins rough, very smooth beneath, slightly hirsute above; spikes six to twelve inches long, erect; spikelets on opposite sides of a jointed and channelled rachis, pubescent on the margin, erect, from four to eight flowered, lower or sterile glumes acute or short-awned, prominently five to seven nerved, flowering glumes smooth, palet acute or somewhat rounded, smooth or slightly pubescent.

HISTORY AND DISTRIBUTION.

Quack grass has long been known as a troublesome weed in Europe and eastern North America, and has probably been common in the eastern part of the United States for a century. According to Flueckiger and Hanbury, the ancients were familiar with several grasses, and among them the common quack grass was well known. It was first described by ¹Linnaeus, the botanist, as *Triticum repen*.

1. Sp. pl. 86, 1753.

thus placing it with the wheat. Beauvois,² however, in 1812 transferred it to the genus *Agropyron*, which was established by Gaertner³ in 1770.

This grass is common and widely distributed from Manitoba, Minnesota, and western Iowa to Arkansas and Texas. In the state of Iowa it has been found and reported in the following localities: Afton Junction, Ames, Armstrong, Iowa and Minnesota line near Ceylon, Elmore, Hamilton county, Hampton, Harcourt, Keokuk,



Fig. 1—Quack Grass (*Agropyron repens* Beauv.). (a) spikelet; (b) parts of spikelet displayed; (2) empty glumes. (Div. of Agros. U. S. Dept. Agri.)

Mason City, Nora Springs, Ontario, and Pilot Mound. Common especially in the loess soil from Carroll to Lyon county eastward. It is found extensively along railroads. It is found especially in northern Iowa from the Mississippi to the Missouri rivers.

The rootstocks of quack grass are used as medicine for the mucous

2. *Agrost.* 146, 1812.

3. *Nov. Comm. Petrop.* 14, 1770.

discharge from the bladder. They also contain about three per cent of sugar and from seven to eight per cent of tritacin.⁴

The rootstock contains, in addition, other gummy matter and some mannite.

WEEDY NATURE OF THE PLANT.

It has been regarded as a troublesome weed in many of the European countries. Many agricultural books and popular botanies of Europe mention it as a plant of weedy nature, and the same is true of the botanies and floras of eastern North America. During the past few seasons many requests have come from northern and north-eastern Iowa with reference to quack grass. The following extracts taken from these letters indicate the seriousness of the pest:

Mr. W. H. Franke of Elmore, Minn., says: "Quack Grass is crowding on here quite fast."

A correspondent of Wallaces' Farmer says: "Please advise me through your paper if Quack Grass would make good pasture; if pastured out, is there any danger of its spreading over the farm?"

Mr. I. N. Drake of Hartley, Iowa, says: "I write to ascertain what can be done to kill Quack Grass. I believe it will gradually take this country. Many of the farmers do not realize what damage this grass is doing to the country."

J. S. Carr, Clear Lake, writes: "Can you send me information regarding the extermination of the Quack Grass? It is quite prevalent in this part of the state."

N. G. Forbes, Clarion, says: "Would be glad to have the name of the grass sent, and what one can do to kill it out, as it seems to be very hard to kill out and it spreads some."

Mr. Oscar O. Fields, Nora Springs, writes: "Enclosed please find sample of a grass that seems to be a pest. It has appeared in spots. I will be thankful for any advice you can give in regard to this plant."

J. H. Balmat, Nora Springs, writes as follows: "Will you please let me know by return mail the name of the grass enclosed. (We call it Quack Grass.) It is hard to get rid of, and almost an impossibility to kill it. The root will turn into tops and the tops will make roots if it gets covered."

Mr. Henry Ponto of Greene, Iowa, sends specimen and writes: "Enclosed please find sample of grass, which I think is Quack Grass. Will it grow from the seed as well as from the root? How can it best be exterminated?"

Mr. C. Ackert of Galva, Iowa, writes: "I herewith send you a sample of grass which is growing on my farm. I would like to know the name of it, and how it can be destroyed. There are several small patches of it, and it is impossible to get rid of it."

Mr. C. S. Allen of Laurens, Iowa, says: "We have a farm that has probably from 10 to 20 acres of Quack Grass started on it, and we are unable to get our tenants to destroy or kill it out. We would like to know if you have had any experience with this grass and what is the best plan to kill it out and destroy it."

Mr. C. E. Legg of Pontiac, Ill., writes as follows: "I have some

4. Pharmacographia, 729.

Formula— $C_{12}H_{22}O_{11}$, a tasteless gummy substance which is easily transformed into sugar when kept at the temperature of 100 degrees C.

land in Northern Iowa on which there has lately started a grass, which the people in that part of the country call Quack Grass. It is spreading very rapidly, and I would be greatly obliged if you can give me some information as to the best method of getting rid of it. Enclosed find sample of grass."

These letters indicate how widespread this grass is in northern Iowa, and with what apprehension it is regarded.

The following note in response to urgent requests to give information on its pestiferous character was published in Wallaces' Farmer:

Quack Grass may be recognized by its long, running, rootstocks; stems from one to three feet high, rather broad, smooth leaves, with numerous spikelets, from four to eight flowers in each spikelet. Spikes three to ten inches long. Quack Grass is a naturalized weed in many sections of this country. It is native to Europe, but is common in the Eastern states. Recently, while on a trip in Minnesota, the writer observed that this weed was extremely common on railway embankments, in fields and waste places. It is also abundant in the vicinity of La Crosse, Wisconsin, and other portions of that section of the state. I recall one particular locality where a few years ago there was an area covered by it not much larger than a quarter of an acre; it now extends over fifteen or twenty acres. I notice also in the vicinity of Ames that the weed is spreading to the cultivated fields.

Quack grass has been condemned and commended by agricultural writers. Prof. Lamson-Scribner,¹ in his book on the "Grasses of Tennessee," says:

Sparingly introduced in cultivated grounds. In some parts of the eastern and middle states it is abundant in open fields. It is a good grass for hay, but its strong creeping rhizomes, which spread rapidly in all directions, render it one of the worst weeds in cultivated lands, hardly less difficult to eradicate than Johnson Grass.

QUACK GRASS AS A FORAGE PLANT.

Quack grass has merit as a forage plant, but one should decide whether he desires to use his field for alternate husbandry or as a permanent meadow. If the former is desired, then quack grass has no merit whatever. It must be treated as a weed. If, however, the field is to be used for a pasture over a long period of years, then quack grass as a forage plant has some merit. The chemical analyses of quack grass, as determined by Dr. Weems, show the following composition, to which we append some analyses from other sources:

CHEMICAL COMPOSITION OF QUACK GRASS IN IOWA.

- Sample 1. Gathered April 18, 1896; height, 4 to 8 inches.
- Sample 2. Gathered May 6, 1896; height, 16 to 24 inches.
- Sample 3. Gathered May 20, 1896; height, 20 to 30 inches.
- Sample 4. Gathered June 1, 1896; height, 26 to 28 inches.
- Sample 5. Gathered June 15, 1896; height, 26 to 28 inches.

1. Bull. Univ. Tenn. Agrl. Exp. Sta. 7:133.

NATURAL CONDITION.

	Water.	Fat.	Protein.	Albuminoids.	Crude Fiber.	Ash.	Nitrogen free Extract.
Sample 1.....	73.96	1.15	5.13	(4.57)	6.13	3.14	10.49
Sample 2.....	79.06	.81	4.41	(2.47)	5.66	3.11	6.95
Sample 3.....	79.56	1.51	4.64	(2.11)	4.96	2.09	7.24
Sample 4.....	75.84	1.47	4.23	(2.04)	6.68	2.66	9.12
Sample 5.....	80.56	1.28	1.35	(1.32)	5.05	2.12	9.64

WATER FREE SUBSTANCE.

Sample 1.....	4.41	19.70	(17.57)	23.55	12.08	40.26
Sample 2.....	3.86	21.06	(11.80)	27.12	14.84	32.12
Sample 3.....	7.37	22.71	(10.34)	24.48	10.24	35.40
Sample 4.....	6.08	17.52	(8.44)	27.56	11.00	37.84
Sample 5.....	6.59	6.96	(6.80)	25.97	10.93	49.55

CHEMICAL COMPOSITION OF QUACK GRASS FROM OTHER SOURCES.

	Water.	Fat.	Protein.	Crude Fiber.	Ash.	Nitrogen free Ex- tract.
Sample 1, cut June 23.....	58.30	1.40	3.67	8.22	3.65	24.76
Sample 2, time of cutting un- known. S. Dak. (2).....	57.62	1.45	3.31	16.20	1.88	19.44
Sample 3, cut June 29, 1891, just coming in bloom.....	7.00	1.93	9.22	33.02	6.93	41.90

WATER FREE SUBSTANCE.

Sample 1.....	3.40	8.80	19.70	8.80	59.30
Sample 2.....	3.40	7.80	35.50	4.50	45.90
Sample 3.....	2.07	9.91	35.51	7.45	45.05

Quack grass is therefore not only nutritious (not as much so, however, as the western wheat grass), but palatable as well. One factor, however, should be taken into consideration, namely, that the grass becomes sod-bound; and in order to renew the same it is occasionally necessary to run over the field with a disc harrow.

METHOD OF EXTERMINATION.

The grass can be exterminated by proper methods of culture. Some years ago an experiment was tried in the extermination of this grass on a portion of the college campus on an area of about one hundred by sixty feet. The writer found it was much easier to exterminate quack grass than horse radish. The field was plowed early in the spring, the season being a dry one; the crop was then given a harrowing, thus exposing all the root stocks, or as many as possible. The field was given a vigorous hoeing every time that the grass appeared. Of course, it must be admitted that the dry season favored the destruction of the plant. It is necessary to observe the precaution, however, that none of the leaves be allowed to appear. The rootstock consists of a series of joints, at the nodes of which little scales occur.

Wherever there is a node a new plant will form. It will be seen, therefore, that it is essential to remove as many rootstocks as possible. Mr. Henry Hatch² says:

This grass grows from the roots as well as from the seed, and as the roots get a start very quickly in wet weather they should be disturbed only during a dry spell. No matter how small or short the root may be, it is sure to grow if torn loose from the parent plant and deposited in moist soil. Plow the field rather shallow, then harrow it thoroughly with a common lever harrow or a spring tooth toll if one is handy. This will then leave a large share of the roots lying on the surface, and after a few drying days they can be raked into windrows and burned. If the work does not seem to be through in the spring, plow again and a little deeper than before, then harrow, rake and burn as before. Probably a few roots will escape and possibly a few seeds will yet be in the soil, so, if it can be done, some cultivated crop had better be grown in the field following this treatment, and all plants that survive cultivation be destroyed with hoes. This grass is as hard to destroy as almost anything that grows, and the only way to do it is to take everything out of the soil in the way of roots, seeds, etc., and completely destroy them by burning or rotting away in a pile.

Mr. V. E. Strayer of Fayette county, Iowa, has found a successful method of eradicating this grass. He describes it as follows in Wallaces' Farmer:

Plow the ground very shallow early in the spring, then harrow until perfectly level, let it lie until about the 25th of June, when the quack grass and other weeds will have reached a large growth. Take three good horses and a sixteen-inch walking plow, and turn the ground over, plowing as deep as possible, using a heavy log chain attached to plow and whiffletree to pull the growth of vegetation into the furrow, so that it will be completely covered. Sow with buckwheat, and harrow lightly with slanting-tooth drag; harrow around the field, in the same direction in which it was plowed, so as not to uncover any of the vegetation that has been turned under or bring any of the quack grass roots to the surface. If the above treatment of ground that is infested with quack grass is carried out, little if any of the weed will be left, and the crop of buckwheat will more than pay for the trouble.

In answer to a query in Wallaces' Farmer,³ the writer made the following statement:

The grass can be exterminated by proper methods of culture and treatment. For the extermination of quack grass the field should be plowed, the rootstocks exposed to the sun by giving the field a thorough harrowing, removed and burned. We should also remember that every severed rootstock of quack grass will give rise to a new plant, hence the importance of having these removed and the importance of preventing the leaves from appearing, as the latter furnish sustenance to the plant. This process of removal must be continued as long as quack grass appears. Various chemical substances have been recommended for its extermination, but, so far as I know, none of these are as successful as the hoe and the cultivator. I am positive that if the

2. Mr. Henry Hatch, *Prairie Farmer*, April 13, 1901.

3. *Wallaces' Farmer*, October 2, 1903.

suggestions recommended are carried out the quack grass may be exterminated. I have seen it done on the College farm and elsewhere.

QUACK GRASS AS A SOIL BINDER.

Quack grass has frequently been recommended as a soil binder, not only where the soil is subject to washouts, as in gulleys and ditches, but also on railroad embankments. The persistent rootstocks make this grass an excellent one for this purpose. It has been used to advantage in parts of Wisconsin for this purpose where washouts are



Fig. 2—False Quack or Couch Grass (*Agropyron pseudo-repens*). (a) empty glumes; (b) flowering glumes with flowers. (Div. Agros. U. S. Dept. Agri.)

frequent. We believe there is no better grass than quack grass as a soil binder.

Experiments made here at Ames show that it is an excellent grass for railroad embankments. Succeeding well on the sunny as well as on the shady slopes. This subject, however, is treated more in detail in another part of this bulletin.

FALSE QUACK GRASS, *AGROPYRON PSEUDO-REPENS*.⁴

This species is quite distinct from the common quack grass. It is widely distributed and referred to by botanists from the states west of the Mississippi river to the Pacific coast.

DESCRIPTION.

False quack grass is an erect rather stout perennial, one and one-half to four and one-half feet, from running rootstocks, with flat, scabrous leaves, and erect spikes four to eight inches long. Spikelets five to eight lines long, three to seven flowered, with linear-lanceolate, nearly equal and five-nerved empty glumes, with acuminate or awn-pointed flowering glumes.

FORAGE VALUE.

False quack grass is an excellent forage grass, being as valuable as the western wheat grass. It is not so tenacious, and is, therefore, much more desirable. Stock of all kinds eat this grass with avidity. Professor Williams⁵ comments as follows on this grass:

These grasses are very generally distributed over this region, and grown naturally on a variety of soils. All respond readily to cultivation. Usually all that is necessary to convert a piece of good sage brush or valley land into wheat grass meadow is to clear off the brush and large stones, keep off the stock, and water the land. The grasses will soon take complete possession. On nearly every well-kept ranch in the eastern Rocky mountain region can be seen fine natural meadows made in this manner.

WESTERN WHEAT GRASS, *AGROPYRON OCCIDENTALE*.

Agropyron occidentale, which has been variously referred to by American botanists, is closely related to quack grass, *Agropyron repens*; indeed, it was for long considered a variety of the latter.⁶

4. Scribner and Smith. Bull. U. S. Dept. Agrl., Div. Agros. 4:34.

5. Bull. U. S. Dept. of Agrl., Div. Agros. 12:39.

6. Britton and Brown, Ill. Fl. 1:26; Watson and Coulter, Gray's Man. 671.



Fig. 3—Western Wheat Grass (*Agropyron occidentale*). (a) empty glumes; (b) flowering glumes with flowers. (Div. Agros. U. S. Dept. Agrl.)

Scribner and Smith⁷ thought that this species was described by Pursh.

The name *Agropyron spicatum* was adopted by Nash.⁸

The name *Agropyron spicatum*, used by Scribner and Smith,⁹ is now also used by Shear and other agrostologists.

7. *Festuca spicata*, Pursh. Flora Am. 1:83. *Triticum Missouriicum*. Sprengel Syst. Veg. 325. 1825.
Agropyron glaucum occidentale, Vasey and Scribner in Macoun's Cat. Canadian Plants 2:242.
8. Britton's Manual, 154.
9. *Agropyron occidentale*, Scribner. N. sp.
Agropyron spicatum (Pursh.), Scribner and Smith. Bull. U. S. Dept. Agrl. Div. Agros., 3:12, 1896. Scribner, Bull. U. S. Dept. Agrl. Div. Agros., 17:298, f. 594, 1899.
Agropyron spicatum. Scribner and Smith. Bull. U. S. Dept. Agrl., Div. Agros. 4:33. 1897.

DESCRIPTION.

Western wheat grass is an erect, smooth, glaucous or pale green perennial, from sixteen inches to four feet tall; with long, slender, creeping rootstocks; leaves smooth, four to eight inches long, acuminate pointed sterile glumes somewhat shorter than the spikelet, hispidulous and with a serrate margin; keel pubescent flowering glume nearly one-half inch long, generally awned or acute, seven-nerved; palea pubescent, keel awnless. This species differs from *Agropyron repens* in its more numerous flowers to the spikelet and larger glumes and compressed ascending spikelets.

FORAGE VALUE.

This wheat grass has been cultivated on the college grounds since the organization of the station.

Mr. R. P. Speer, the first director of the Experiment Station, set out a considerable area of this grass from seed obtained from Montana and the Northwest. The grass proved not only hardy, but gave splendid returns. Since then the writer has had this grass under observation, and can say that it is a promising species and well adapted to certain sections of the state.

During the season of 1900 it measured two feet and three inches; usually, however, it is from one and one-half to two feet high. It produces an abundance of leaves. The grass does not produce so large a bulk as timothy and slender wheat grass or brome grass.¹⁰ "A pound of western wheat grass contains more nutrient material than either blue grass or timothy. It stands drouth in a remarkable manner; the leaves and stems are bright and green during the driest weather." This grass is especially well adapted to drier soils. The loess soils of western Iowa are well suited to it, and so are the sandy soils in the Muscatine Islands, and the gravelly knolls in the drift area of the state.

This grass has been cultivated on the college farm in an experimental way since 1889, both in plats and in rows. Even in one season from the seed the grass will produce a fair crop of hay of the best quality. In no instance has this grass given trouble after it was desired to cultivate the field. In one instance a row was planted across a ten-acre field, but one season's thorough cultivation removed all vestige of this grass; and at other points where it has been planted the grass has been entirely removed. While it is true that it produces the same kind of rootstock as the quack grass, it is easier destroyed in

10. Grasses of Iowa, Bull. Geological Sur. 1:107.

this humid climate than quack grass, unless it should develop characteristics more like this grass.

In 1900 Mr. W. N. Greenman sent to Professor C. F. Curtiss a grass that he found growing in the driest kind of soil along the embankment of the C., R. I. & P. railway near Fruitland on Muscatine Island. The grass appeared so thrifty during the dry weather that he was desirous of knowing the name and whether it was of any value for forage purposes.

In response to this query, I suggested that the same be planted on the island; that it would prove a valuable forage plant under the conditions existing there. Later I received a communication from Mr. R. T. Hummel of the island, who had seen the grass growing in an experimental way by Mr. Greenman. I suggested to Mr. Hummel also the use of this grass for forage purposes on the island.

In a recent visit to the Island, I found that the grass grown by Mr. Greenman was doing admirably, and that he expected from 2 to 3 tons per acre when the seasons are favorable. With the dry seasons the yield would probably not be more than a ton or a ton and a half per acre. He states further that he has no difficulty in keeping a good stand by running a disc harrow through his pasture, but he has experienced a little difficulty from obtaining seeds from his plant.

The Division of Agrostology, U. S. Department of Agriculture, through the efforts of Mr. Hummel, has distributed some seed among the farmers on the island. In my judgment, this is one of the best grasses for the island and will greatly help the people of the island.

Where this grass is used for meadow purposes, it becomes sod-bound. It has been found in the Dakotas and Montana, and even here in Iowa where it has been cultivated after three or four cuttings the yield diminishes greatly, and to obviate this difficulty the meadow is dragged over with a sharp-toothed harrow, or occasionally disced. This breaks up the small rootstocks and gives the plant greater vigor. Every severed rootstock of the root makes a new plant. This grass will be found highly useful on the loess soils along the Missouri river and other sterile soils in different sections of the state. In a recent bulletin of the Nebraska Agricultural Station Professors Hitchcock and Lyon¹¹ speak as follows concerning this grass:

Western Wheat Grass (*Agropyron occidentale*) is a common grass in the western portion of the Great Plains, extending into the mountains. It propagates by stout creeping rootstocks, but does not form a close sod. In the west, from Colorado to Montana, it is called Bluestem, Colorado bluestem, or Colorado grass, and forms the bulk of the native hay of this region. It grows on bench land and though the yield per acre is not large, yet it furnishes more hay than any other common

11. Bull. 84 Neb. Agrl. Exp. Sta. 37.

grass of this region. The foliage is stiff and harsh, but the quality of the hay is good and it is eaten by stock.

The trials on the Station plats were satisfactory. Where a good stand was obtained, the plant showed that it could withstand drouth and produce a good crop of hay. One plat of one-fifth acre, sown in 1901, and, on account of the poor stand, resown the following year, produced June 23, 1903, 457 pounds of hay, or at the rate of 2,485 pounds per acre.

The writer¹² made this statement:

This is in fact one of the most promising of our native hay grasses. The seed is produced in abundance and is easily gathered. Experiments at stations in the arid regions have usually given good reports.

Dr. Kennedy¹³ says:

While it does not produce as much hay to the acre as some other species, stockmen value it highly for its nutritive qualities. In Montana and the neighboring states it furnishes a considerable amount of native hay and pasturage, and is there regarded as one of the most important forage plants. This grass would make an excellent hay, and should be introduced into cultivation.

Professor Thomas A. Williams,¹⁴ in speaking of this grass, says:

Western Wheat Grass is usually more abundant than either of the other sorts, and it is not an uncommon thing to see a meadow of 40, 80, or more acres composed almost exclusively of this grass. Without irrigation it is rarely possible to cut more than one crop in two years, as the grass requires time to recuperate. Even with irrigation it is seldom possible to obtain good crops for many consecutive years without cutting up the sod to overcome its "hidebound" condition and give opportunity for the growth of new shoots. Under favorable conditions, however, these meadows may yield good crops for a number of years with nothing more than proper watering. Mr. Griffiths reports seeing a meadow of about 40 acres in the past season, near Snoma, S. Dak., yielding a crop of about two tons of hay per acre, which had afforded a good crop for five consecutive seasons.

Mr. Elias Nelson¹⁵ speaks of its valuable qualities as a forage plant, as follows:

This Wheat Grass is highly esteemed by our stockmen both for pasture and for hay. As a pasture grass it is of considerable importance in this state on account of its drouth-resisting qualities and great abundance. Some stockmen have succeeded in materially increasing the forage value of their grazing land by gathering and scattering seed of this grass over worn spots in pastures.

Professor Aven Nelson, in speaking of the grasses of the drier regions, mentions as especially worthy the wheat grasses because they produce a forage of great value, and they have a dual purpose; that is, they may be used for pasture as well as for meadow purposes.

The western wheat grass is one of the most valuable native grasses

12. Bull. Iowa. Geological Sur., Grasses of Iowa, 1:372.

13. Bull. U. S. Dept. Agrl., Div. Agros. 22:86.

14. Bull. U. S. Dept. Agrl., Div. Agros. 12:39-40.

15. Bull. Wyo. Agrl. Exp. Sta. 59:22.

of the Missouri river region, not only for hay, but also as a pasture grass. According to Dr. Weems,¹ the chemical analyses of the grass is as follows:

CHEMICAL COMPOSITION.

Sample 1. June 10, 1896; wild along railroad, 30 to 32 inches high.

Sample 2. June 20, 1896; 32 to 34 inches high.

NATURAL CONDITION.

Water.	Fat.	Protein.	Albuminoids.	Crude Fiber.	Ash.	Nitrogen free Extract.
62.64	1.76	4.56	(3.80)	10.91	3.34	16.79
64.63	.83	3.52	(3.07)	12.07	2.74	16.11

WATER FREE SUBSTANCE.

4.72	12.20	(11.90)	29.21	8.93	44.94
2.34	9.95	(8.69)	34.14	7.75	45.82

WESTERN WHEAT GRASS FOR RAILROAD EMBANKMENTS.

Western wheat grass has been widely established in different places in Iowa and elsewhere along railroad embankments. Its glaucous green appearance makes it easily recognizable from a distance. It has established itself along the highest and driest places, spreading along the high inclines in a most satisfactory way.

Several years ago an experiment was conducted along the right-of-way of the Chicago & Northwestern railroad, the rootstocks of this grass being used and also a sod four inches wide. The sod was planted in the fall on the sunny side of the railroad embankment and came through the winter in good shape. The small rootstocks also readily spread from the places where they were planted on the bank. As it is an easy matter to obtain this seed, and as the same germinates readily, the most feasible way to use western wheat grass for planting along railroad embankments is to sow the seed in the fall at the rate of forty-five pounds per acre.

SLENDER WHEAT GRASS, *AGROPYRON TENERUM*.
VASEY.

HISTORY.

Slender wheat grass, *Agropyron tenerum*, was described by Vasey.²

Most American agrostologists and botanists have recognized it as a good species.³

1. Geological Survey, Grasses of Iowa, Bull. 1:370-373-375.

2. Bot. Gaz., 10:258. 1885.

3. Watson and Coulter. Gray. Man. Bot. 672. (6 ed.). Scribner and Smith, Bull. U. S. Dept. Agr., Div. Agros., 4:29. 1887. Nash in Britton and Brown. Ill. Fl. 1:227. f. 527. 1896. Scribner. Bull. U. S. Dept. Agr., Div. Agros. 17:297. f. 593. 1889.



Fig. 4—Slender Wheat Grass (*Agropyron tenerum*). (a) empty glumes; (b) flowering glumes, with flowers. (Div. Agros. U. S. Dept. Agrl.)

It is certainly a distinct species. Its method of propagation, being destitute of running rootstocks, makes it quite distinct from either *Agropyron occidentale* or *Agropyron repens*. It has been recognized as a very promising grass for cultivation by numerous botanists such as Cassidy, Scribner, and others.³

DESCRIPTION.

Slender wheat grass is an erect, caespitose, rather stout, smooth perennial, from three to four and one-half feet high with narrow,

3. Nelson. A. Bull. Univ. Wyo., Agrl. Exp. Sta., 42:42. A. and E. Nelson, Bull. Univ. Wyo. Agrl. Exp. Sta., 59:30. D. H. Saunders, Bull. S. Dak. Agrl. Col. Exp. Sta., 69:26.

flat leaves, and slender cylindrical spikes from four to seven and one-half inches long. Outer glumes five-nerved, hispid; flowering glumes lanceolate four to five lines long, less hispid than the outer glumes, tipped with a straight, stiff awn from one-half to two lines long.

DISTRIBUTION.

The slender wheat grass, though not a native of many parts of this state, originally found in northern and northwestern Iowa, has now been naturalized in many places, as in eastern and central Iowa.

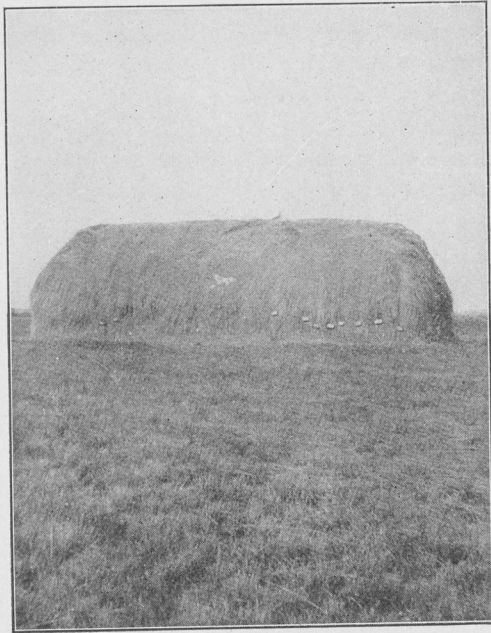


Fig. 5—Hay stack of Slender Wheat Grass in Dakota. (L. H. Pammel, Photograph.)

This perennial grass produces an abundance of soft leaves and stems greatly relished by stock. It has been under cultivation at Ames with remarkable success. It starts early in the spring, surpassing blue grass, especially in its rapid growth and maturity. It is a deservedly popular grass in the Rocky Mountain region.

FORAGE VALUE.

This grass has received some attention because of its value for forage purposes. The writer saw a field of considerable size in the

vicinity of Fargo, North Dakota. The yield was not only excellent, but it produced hay of the best quality. It is likewise highly commended in other sections of the Dakotas.⁴

Professor T. A. Williams,⁵ speaking of this grass, says:

This is one of the best wheat-grasses. It is not so aggressive as some of the other species, as it does not spread by means of underground stems. It responds quickly to cultivation and gives heavy yields of first-class hay. It should receive more attention from farmers and stock raisers.

Dr. P. Beveridge Kennedy,⁶ from the results of a large number of co-operative experiments with the Department of Agriculture, states:

It forms a close, uniform growth that yields as much per acre as an average field of timothy. Considering its high nutritive value no more profitable grass could be found for dry regions, especially on saline soils.

The United States Department of Agriculture sent out numerous packages of seeds, and from ten different states received very favorable reports from Colorado to South Dakota. Professor Aven Nelson,⁷ speaking of the value of this grass says:

It makes a meager growth in dry, sterile soil, but responds promptly to all cultural advantages even in soil that is somewhat impregnated with alkali, yielding as much per acre as the average yields of timothy.

Mr. Elias Nelson⁸ states:

The hay was not relished by the station horses accustomed to hay ration of alfalfa.

Professors Hitchcock and T. L. Lyon find that in Nebraska it succeeds well. They refer to its value especially for the northern states. The seeding habits of this grass are good, and it gives promise for meeting the requirements of a hay grass for the northwest.

From various experiments it seems certain that the best quality of hay can be obtained when it is coming into bloom, and from our own experience in this state and elsewhere we can recommend this grass for the northwestern sections of the state.

4. D. A. Saunders, S. Dak. Agrl. Exp. Sta. Bull., 69:26.

5. Bull. U. S. Dept. Agrl., Div. Agros., 6:25.

6. Bull. U. S. Dept. Agrl. Div. Agros., 22:16.

7. Bull. Wyo. Agrl. Exp. Sta., 42:42.

8. Bull. Wyo. Agrl. Sta., 59:31.

CHEMICAL ANALYSES.

The chemical analysis of slender wheat grass, as given by Professor Shepard,⁹ is as follows:

	Air Dry Substance.	Water Free Substance.
Water	4.50
Ash	8.37	8.76
Ether Extract	2.90	3.00
Crude Fiber	30.61	32.00
Crude Protein	9.56	10.01
N-free Extract	44.06	46.23
<hr/>		
Total Nitrogen	1.53	1.60
Albuminoid Nitrogen	1.38	1.44

In dry soils throughout the Northwest it does well under cultivation, giving nearly as large yields as the Grama Grass. It is a close relative of the wheat and is more subject to red and black rust than wheat. The hay is high in nutriment according to the analysis. The hay was gathered from the Station plats, which were sown with seed obtained from the Experiment Station at Brandon, Manitoba.

SEEDING.

The best success will be obtained by sowing early in the spring or early in September. The ground should be in a good stage of tilth. It should be sown at the rate of forty pounds per acre. The seed may be obtained from several dealers in the northern states.

RICHARDSON'S WHEAT GRASS, *AGROPYRON*
RICHARDSONI. SCHRAD.

HISTORY.

The Richardson wheat grass was described by Schrader in 1838. It has been known to American agrostologists for a long time under various names, such as *Agropyron unilaterale*, Cassidy,¹ and was referred to as *Agropyron caninum*,² but it is clearly distinguished from this species which we have described in another part of the bulletin; and Beal³ refers to this species as *Agropyron violascens* (R. Pond).⁴ four feet high with somewhat roughened pointed involute leaves,⁵

DESCRIPTION.

Agropyron Richardsoni is an erect smooth perennial from three to four feet high with somewhat roughened pointed involute leaves,⁵

9. Bull. S. Dak. Agrl. Exp. Sta., 69:27.
1. Bull. Colo. Agrl. Exp. Sta., 12:63. 1890.
2. Nash in Britton and Brown. Ill. Fl., 1:228 (in part).
3. Grasses of N. A., 2:635. 1896.
4. Minn. Bot. Studies, 9 (III.):107. 1894.
5. Bull., Pt. II., Grasses of Iowa, 315.

the erect usually one-sided bearded spikes fourteen to twenty inches long. Spikelets three to four-flowered; the outer glumes awned, hispidulous and roughened; flowering glumes hispidulous and roughened; long awned.



Fig. 6—Awned Wheat Grass (*Agropyron caninum*). (a) empty glumes; (b) flowering glume. (Charlotte M. King.)

DISTRIBUTION.

Native only to northwestern Iowa, occasionally naturalized farther eastward.

FORAGE VALUE.

Richardson's wheat grass is not as valuable as the slender wheat grass, though it has merit in places where it occurs in natural meadows. It should be said that this grass makes a leafy growth, the plants heading out rather late, maturing, therefore, later than slender wheat grass.

AWNED WHEAT GRASS, *AGROPYRON CANINUM*.

HISTORY.

This has been known to European botanists since early in the last century. It is undoubtedly closely related to Richardson's wheat grass.



Fig. 7—Soft Western Wheat Grass (*Agropyron occidentale* var. *molle.*). (a) spikelet; (b) flowering glume; (c) palea and anther; (d) empty glumes. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

Awned wheat grass is a slender perennial grass from one to three feet high without creeping rootstocks. Sheaths smooth; or the lower hairy, slender, flat leaves pubescent above, smooth below; the nodding spikes three to six inches long. Spikelets three to six-flowered, rather

distant; outer glumes acute or long-awned, five-nerved, flowering glumes long-awned.

DISTRIBUTION.

Common in the north, but in Iowa occurring only in northwestern section of the state. From New Brunswick, Saskatchewan, and British Columbia, south to Colorado; south through New England and middle states and west to Nevada and Wyoming.

FORAGE VALUE.

As a forage plant it has about the same value as the Richardson's wheat grass.

SOIL BINDING GRASSES.

BY L. H. PAMMEL.

After a discussion of quack and wheat grasses it seems appropriate to consider the above subject, which is more or less intimately connected in the interior of our country with these grasses. Queries have frequently come to this section with reference to this matter, especially how to hold soils that are badly washed or gullied. The request has also come for information in regard to the large "fills" made by railroads to improve and better road beds. By making these "fills" heavy grades are avoided. Much of the soil in these "fills" is annually washed by our heavy rains, making it a matter of considerable expense to the railroads to replace the soil washed away by the rains.

HISTORY.

Much has been written on the subject, especially as it applies to the holding of shifting sands on the sea coast or larger lakes and the sand dunes in the interior of continents. Prof. F. Lamson-Scribner¹ in an excellent popular treatise has given an account of the main facts pertaining to the subject, especially the grasses serviceable for the purpose.

Paul Gerhardt,² of Germany, has published a book in which detailed accounts are given of the sand dunes of Germany. H. C. Cowles made a detailed study of the sand dunes of Lake Michigan. It is by far the best and most detailed of the ecological studies made on the subject in America. More recently the Division of Agrostology of the United States Department of Agriculture has taken up the matter of studying the sand dunes. Two papers have been published by the division, one by Prof. A. S. Hitchcock, entitled "Methods Used for Controlling and Reclaiming Sand Dunes." Professor Hitchcock was sent by the government³ to study the methods used in Europe to find out how far those methods might be applicable to America. Mr. Westgate, assistant in the same division, in addition to his work on the Cape Cod region, where the government and the state of Massachusetts have spent large sums of money to protect the harbor,

1. Year Book U. S. Dept. Agrl. 1884:421; 1898:405.

2. Handbuch des deutschen Dunenbaues, Berlin, 1900.

3. Bull. U. S. Dept. of Agrl. Bur. Pl. Ind. 57.

is also studying the sand dunes in the interior of the country. In his paper on "The Reclamation of Cape Cod Sand Dunes" he treats not only the ecological phases, but the practical side of the question.⁴

QUACK GRASS AND WESTERN WHEAT GRASS AS SOIL BINDERS.



Fig. 8—Planting Quack Grass and Blue Grass on the grade of the C. & N. W. Railroad between Ames and Ontario. (Miss Barber, Photograph.)

Quack grass has been recommended as a soil binder for railroad embankments. The writer undertook an experiment in co-operation with the Chicago & Northwestern Railway Company to determine whether it would be possible to utilize this grass for such purposes. The point selected was a high "fill" between the city of Ames and Ontario. The first experiment consisted in collecting the rootstocks in the spring and planting them in rows run up and down the embankment. The first season the plants made very little growth. The second season they spread considerably. The plant makes much more satisfactory progress if planted on the north side than on the south; the western wheat grass is much better suited to such situations. This method is not economical, as it is a matter of considerable expense to plant the high "fills" in this way.

In the experiment undertaken we also used timothy, Hungarian

4. Bull. U. S. Dept. of Agrl. Bur. Pl. Ind. 65.

brome grass (*Bromus inermis*), Canadian blue grass (*Poa compressa*), sheep's fescue (*Festuca ovina*), blue grass (*Poa pratensis*), western wheat grass (*Agropyron occidentale*), *Bromus marginatus*, orchard grass (*Dutcyllis glomerata*), a sedge (*Carex*) growing on the edge of the "fill," and red and white clover. It was not difficult to get a stand of the red and white clover. In fact, on the north side of the track the plant blossomed very well by the end of the season, but the cold weather destroyed many of the plants. Some, however, remained, and by sowing an additional quantity of red and white clover seed in the spring of 1904 we had an excellent stand on the north side of the track. On the south side it was difficult to get a start owing to the dryness of the soil. The Hungarian brome grass, which was sown just as the other grasses were, made an excellent start on the north side, and here and there a patch on the south side.

The sod material, obtained from Brookings, South Dakota, through the kindness of Prof. James Wilson, planted in the fall, came through the winter well and made an excellent growth. It is much more economical, however, to sow the brome grass seed late in the fall or very early in the spring.

The sedge was a total failure. The intense heat and dryness made it impossible for this plant to get a good start. The orchard grass grew well on the north slope but its habit of growth makes it undesirable. Blue grass was nearly a failure on the south slope, but succeeded much better on the north and shady slope.

From our experience we would advise the planting of brome grass and blue grass upon the north side of the track, and if properly handled this will make a good sod in the course of a few years, but the young plants should be protected with red and white clover. On the south side of the track we would advise the planting of western wheat grass and some Canadian blue grass.

Objection may be raised on the use of quack grass for this purpose, as it is likely to spread to the adjoining fields. This, of course, is true, and must be carefully considered by the railroad companies. The same objection from our experience does not apply to western wheat grass, which is naturalized at many points along our railroads. It succeeds well on the sunny side and may be destroyed much more easily than quack grass.

An important point in connection with this work is the matter of starting the grass. The sod or rootstock method of planting is rather laborious and expensive. The seed of Hungarian brome grass is on the market, while the western wheat grass seeds abundantly and it may be obtained in the market or arrangements can be made to collect it in the west.



Fig. 9—Blue Grass, Brome Grass and Western Wheat Grass on embankment.
(C. M. King, Photograph.)

HOLDING OF GULLIES.

As to the matter of protecting gullies or washouts in fields, there is no better grass than quack grass. This land is all waste and is of no use agriculturally. The best way to treat such places is to sow thickly with quack grass and re-enforce the banks with willow plantings. If this is not done more and more agricultural land will be consumed. This subject should be treated more at length at some future time by the botanical and forestry sections of the station.

HOLDING OF SHIFTING SANDS.

There are a few sand dunes in the state. Most of these are found in the eastern part of the state along the Mississippi river. Some complaint has been made by Muscatine Island farmers on the drifting sands of the islands. Through cultivation the native vegetation has been to a large extent removed. These "billows" of sand move and spread over the adjoining fields. Agriculturally these billows are worth but little. They are a menace to the better adjacent fields. These sands contain the following native plants: A species of sedge

(*Carex Schweinitzii*), bur grass (*Cenchrus tribuloides*), *Polygonum tenue*, *Commelina Virginica* *Breweria Pickeringii*, *Ceanothus ovatus*, *Bouteloua hirsuta*, *Sporobolus cryptandrus*. The open drifting sands should be planted with sand grass (*Calamovilfa longifolia*), which succeeds admirably in such places. The heavier soil covered with native plants and a little grass should be planted with western wheat grass. This succeeds well in poor soil. In time the whole will be redeemed to agriculture.

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